

Computer-Controlled Force Generator, Phase II

Completed Technology Project (2013 - 2015)



Project Introduction

TDA Research, Inc. is developing a compact, low power, Next-Generation Exercise Device (NGRED) that can generate any force between 5 and 600 lbf. We use a closed loop control system and a servo motor to smoothly and accurately simulate the gravitational and inertial loads of lifting a weight on earth. However, because the system uses a computer-controlled motor, the load can be varied independently during the concentric and eccentric phase of the exercise. Thus, the system can easily provide an eccentric overload during the return stroke, greatly increasing the physiological benefit of a workout. The NGRED has a user-friendly interface where the exercise is selected from a drop-down menu, along with the desired weight and overload. The NGRED will automatically adjust to the user's stored range of motion (ROM) for the selected exercise and apply the set load only during the ROM. The NGRED automatically applies the eccentric overload at the top of the ROM and advances to the next rep at the bottom. The time required to change between users, exercises, and weights is less than 10 seconds. This makes much better use of the astronaut's time; with current mechanically adjustable exercise machines up to two thirds of the time is spent adjusting the machine. The software includes data logging and communication abilities to meet NASA requirements as well as redundant hardware and software fail-safe mechanisms. The NGRED includes an efficient energy recovery system which stores the energy generated by the user during the concentric phase of the motion (pull stroke) and applies that energy to provide resistance during the eccentric phase (return stroke). The average power consumption of the NGRED will be less than 50 W during an exercise session. The expected weight of the NGRED at the end of Phase II will be 20 kg, and the total volume is expected to be 55 L, including all electronics and controls. A flight-like NGRED will be delivered to NASA at the end of Phase II.



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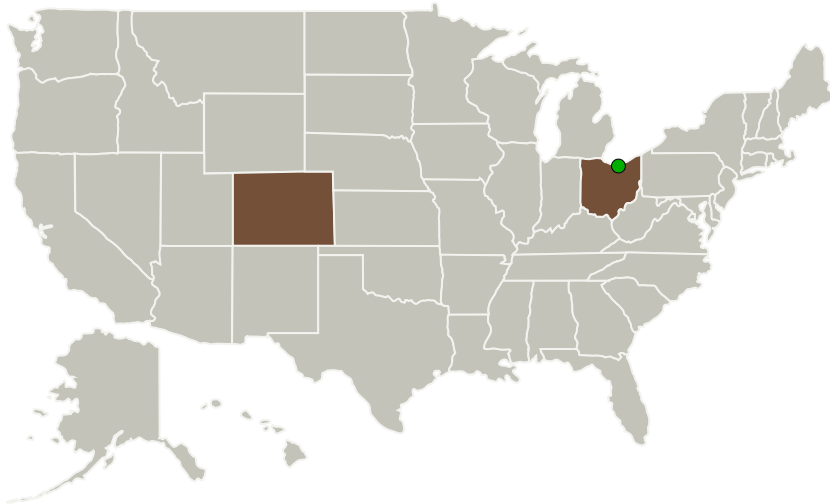
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
TDA Research, Inc.	Lead Organization	Industry	Wheat Ridge, Colorado
● Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations

Colorado

Ohio

Project Transitions

**January 2013:** Project Start**July 2015:** Closed out**Closeout Documentation:**

- Final Summary Chart(<https://techport.nasa.gov/file/137317>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

TDA Research, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

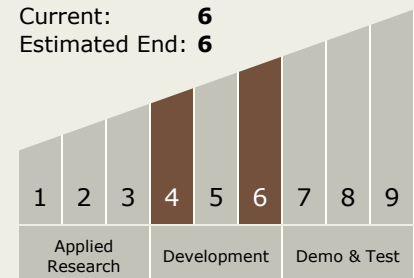
Carlos Torrez

Principal Investigator:

Douwe Bruinsma

Technology Maturity (TRL)

Start: 4
 Current: 6
 Estimated End: 6



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Images



Briefing Chart

Computer-Controlled Force
Generator, Phase II

(<https://techport.nasa.gov/image/131385>)

Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
 - └ TX06.3 Human Health and Performance
 - └ TX06.3.2 Prevention and Countermeasures

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System